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LISTS OF SPECIES

Odonates of three selected tiger reserves of Madhya Pradesh, Central India

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ABSTRACT: Odonates (Damselflies and Dragonflies) were recorded from three Tiger Reserves of Madhya Pradesh, Central India, including Kanha, Pench and Bandhavgarh, where 47 species were recorded within 7 families and 31 genera. We recorded 44 species from Kanha, 41 species from Pench and 37 species from Bandhabgarh Tiger Reserve. Thirty-five species were recorded in all three tiger reserves. Suborder Zygoptera was represented by the families Coenagrionidae, Lestidae, Calopterygidae and Protoneuridae and suborder Anisoptera by the families Gomphidae, Libellulidae and Aeshnidae. Libellulidae was the largest family with 17 genera. In summer survey *Orthetrum sabina* Drury, 1770 was the most abundant species, while in winter the most abundant was *Agriocnemis pygmea* Rambur, 1842.

INTRODUCTION

India has a unique and exceptionally rich and wide-ranging flora and fauna, and Central India is known for its distinctive and varied geographical features topography, soil, climate and vegetation. Almost, the whole of Central India lies on the Peninsular Plateau. Many hill ranges like Vindhya, Satpura, Aravali, Maikal and Ajanta are located in the region and support a unique and varied flora and fauna. The Narmada, Tapti and Pench are some major river systems of this region, where they play an important role to regulate in the lives of human and wildlife. From wildlife conservation viewpoint the area is mainly known for large mammalian fauna such as tiger, leopard and their prey animals followed by the avian community. Very little information is available on invertebrate fauna like odonates, which are one of the least studied groups of insects (Caastella, 1987) and are known as bio-indicators in natural ecosystems (Samways & Steytler, 1996; Chovanec & Waringer, 2001; Smith *et al.* 2007; Silva *et al.* 2010). In the present study we selected three key tiger reserves of Central India for collection of information on odonates, being all in the Madhya Pradesh State. Thus, the aim of the study was to collect baseline data of this group of insects and also to explore their diversity in these Tiger Reserves.

MATERIALS AND METHODS

Study Area and Vegetation

Three prominent Tiger reserves were selected from Central India (Figure 1), which are mainly well known for the presence of big cats and large herbivores. They were Kanha Tiger Reserve (900 km^2), Pench Tiger Reserve (757.9 km^2) and Bandhabgarh Tiger Reserve (694 km^2). The broad vegetation pattern of Central India is Dry Deciduous Forest. However, Champion and Seth (1968) have identified three forest types in Kanha Tiger Reserve (22°20′0″ N, 80°38′0″ E^2): 1. Moist Peninsular Sal Forest (a. High Level Sal, b. Low Level Sal, c. Valley Sal) 2. Southern Tropical Moist Deciduous Forest, 3. Southern Tropical Dry Mixed Deciduous Forest. The area has tropical deciduous forests dominated by Sal (*Shorea robusta*), with the associates such as, Saja (Terminalia alata), Lendia (*Lagerstroemia parviflora*), Dhawa (*Anogeissus latifolia*), Tendu (*Diospyrus melanoxylon*), Palash (*Butea monosperma*), Bija (*Pterocarpus marsupium*), Mahua (*Madhuca indica*), Aonla (Emblica officianalis), Achar (Buchnania lanzan). The major grass species include *Eragostis* sps., *Andropogon* sps., *Cynodon* sps.and *Bambusa* sps.

The Pench Tiger Reserve (21°38'0" N, 79°25'0" E) is spread over two districts, Seoni and Chhindwara of Madhya Pradesh, India. The reserve is mainly supports a tropical deciduous teak (*Tectona grandis*) forest with associated species such as Mahua (*Madhuca indica*), Tendu (*Diospyros melanoxylon*), Saja (*Terminalia tomentosa*), Achar (*Buchanania lanzan*), Landia (*Lagerstroemia parviflora*), Bija (*Pterocarpus marsupium*), Kari (*Miliusa velutina*), Mawai (*Lannea coromandalica*), Haldu (*Adina cardifolia*), Aonla (*Emblica officinalis*), Amaltas (*Cassia fistula*) occurring on

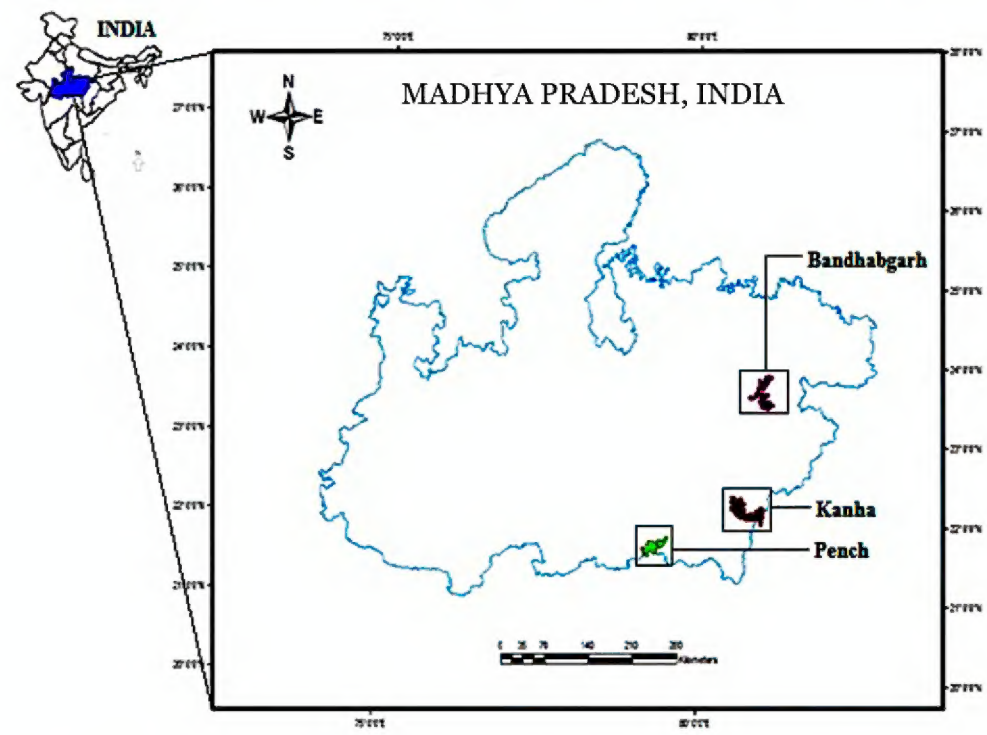

FIGURE 1. Map of India showing three selected Tiger Reserves of Madhya Pradesh.

flat terrain and representing a transition from tropical dry deciduous to tropical moist deciduous forests. In some parts of the forest Garari (*Cleistanthus collinus*) dominant patches are present. The undulating terrain and hill slopes have patches of Mixed Forest dominated by Salai (*Boswellia serrata)* and Dhaora (*Anogeissus latifolia*). On rocky slopes species like dazzling white Kulu (*Sterculia urens*) and Papra (*Gardenia latifolia*) are visible. Species like Arjuna (*Terminalia arjuna),* Jamun (*Syzygium cumini*) and Lokhandi (*Ixora parviflora*) represents the evergreen trees inside the forest and they are familiar in riparian vegetation along nullahs and river banks. The reserve is named after the Pench River, that flows from north to south through the Pench (Dwivedi 2003).

Bandhavgarh (23°30'0" N, 80°47'0" E) lies on the extreme north eastern border of the state of Madhya Pradesh and the northern flanks of the eastern Satpura mountain range at altitudes between 410m and 810m. Like Kanha the major forest type in the reserve is Tropical Moist Deciduous Forests with dominant Species such as Sal *Shorea robusta.* Certain areas are marshy and support a wide variety of wildlife and the dense green vegetation at the Bandhabgarh forests is dotted with ruins of ancient monuments..

Methodology

The study was carried out from January, 2010 to May, 2011. With the permission from the Forest Department of Madhya Pradesh, the odonates were collected in conjunction with "Monitoring Tigers, Co-predators, Prey and Their Habitats" in these respective sites. Twice a week, data were collected and direct search technique (Sutherland,1996) was used during the period of 1000 to 1400 hours, because odonates are found mostly active during midday due to their dependence on sunlight directly to regulate their body temperature. Opportunistic sightings were also recorded. The identification of dragonflies and damselflies is based on Subramanian (2009) and Fraser (1933-36). The classification scheme follows Schorr *et al.* (2006). Family and species level classification follows Prasad and Varshney (1995). A Nikon P90 digital camera with double close up mode was used to capture the photographs of some species, but we also used dragonfly net to collect samples, which minimized the risk of erroneous identification.

Results and Discussion

In the present study 47 species belonging to 31 genera in seven families of Zygoptera (Damselfies) and Anisoptera (Dragonflies) were reported from the three selected tiger reserves, being 44 species from Kanha, 41 species from Pench and 37 from Bandhavgarh Tiger Reserve. Thirty-five species were recorded in all three tiger reserves. A detailed systematic list with their occurrences is given in Table.1, as well as photographs of some collected species (Figures 2 and 3). Among these odonates, Libellulidae is the largest family with 17 genera and 26 species followed by Coenagrionidae (10), Lestidae (3), Aeshnidae (3), Calopterygidae (2), Gomphidae (2) and Platystictidae (1). In summer (March-June) survey *Orthetrum sabina* Drury 1770 was the most abundant species followed by *Diplacodes trivialis* Rambur 1842, *Pantala flavescens* Fabricius1798,*Crocothemis servilia* Drury 1770, *Brachydiplax sobrina* Rambur,1842 (Figure 3B) and *Brachythemis contaminate* Fabricius 1793. But in winter (November-February) *Agriocnemis pygmea* Rambur, 1842 (Figure 2C), *Ceriagrion coromandelianum* Fabricius 1798, *Ischnura senegalensis* Rambur 1842, *Pseudagrion microcephalum* Rambur 1842 and *Ischnura aurora* Brauer 1865 (Figure 2B) were mostly sighted.

Central India is well known for tigers (*Panthera tigris*) and their prey animals such as chital (*Axis axis*), sambar (*Rusa unicolor*), gaur (*Bos gaurus*) and other herbivores. However, little information regarding odonates is available from this region. The state is reported as habitat to 70 species of odonates (Mishra, 2007). Andrew *et al.* (2008) recorded 45 species of odonates from Central India mainly from in and around the Nagpur City. The study revealed that all three tiger reserves in Central India, has different type of habitat provides fine opportunity to these insects (also considered to be environmental bio-indicator, see Watson *et al.* 1982) to survive. Previously 32 species of odonates was reported from Bandhavgarh Tiger Reserve of Madhya Pradesh Mishra (2009) and 36 species also was reported earlier to Kanha National Park (Tiple *et al.* 2011). Approximately 6500 Odonata species exist worldwide representing about 600 genera (Vick, 2002). Odonata occupy almost all kinds of habitats along the habitat permanence gradient ranging from permanent running waters and lakes to small temporary rain pools (Corbet, 1999). These insects were widely distributed during the monsoon season, but we found that scarcity of water during the summer season creates a challenge to their survival because their lifecycle mainly depend upon aquatic environment. Water scarcity forced them to cluster around available water bodies or moist areas. Due to the dry habitat type in Central India, forest fire is a common phenomenon which decreases the microhabitat for these insects. Several developmental activities around the reserves also create negative impacts on the population of the odonates as suitable habitat is being destroyed by such activities. This may lead to local extinction of vulnerable species. To conserve in their natural habitat these bio-indicators and regulators of harmful insects in our ecosystems public awareness is necessary, because still in India wildlife conservation only focused on large mammals, especially in Central India. The limitation of this study is that it covers only three tiger reserves and includes information on diversity only, but did not investigate different habitats used by different species in relation to seasonal variation. Therefore an overall odonatological survey needs to be carried out to discover the rich diversity of odonates and their habitat use.

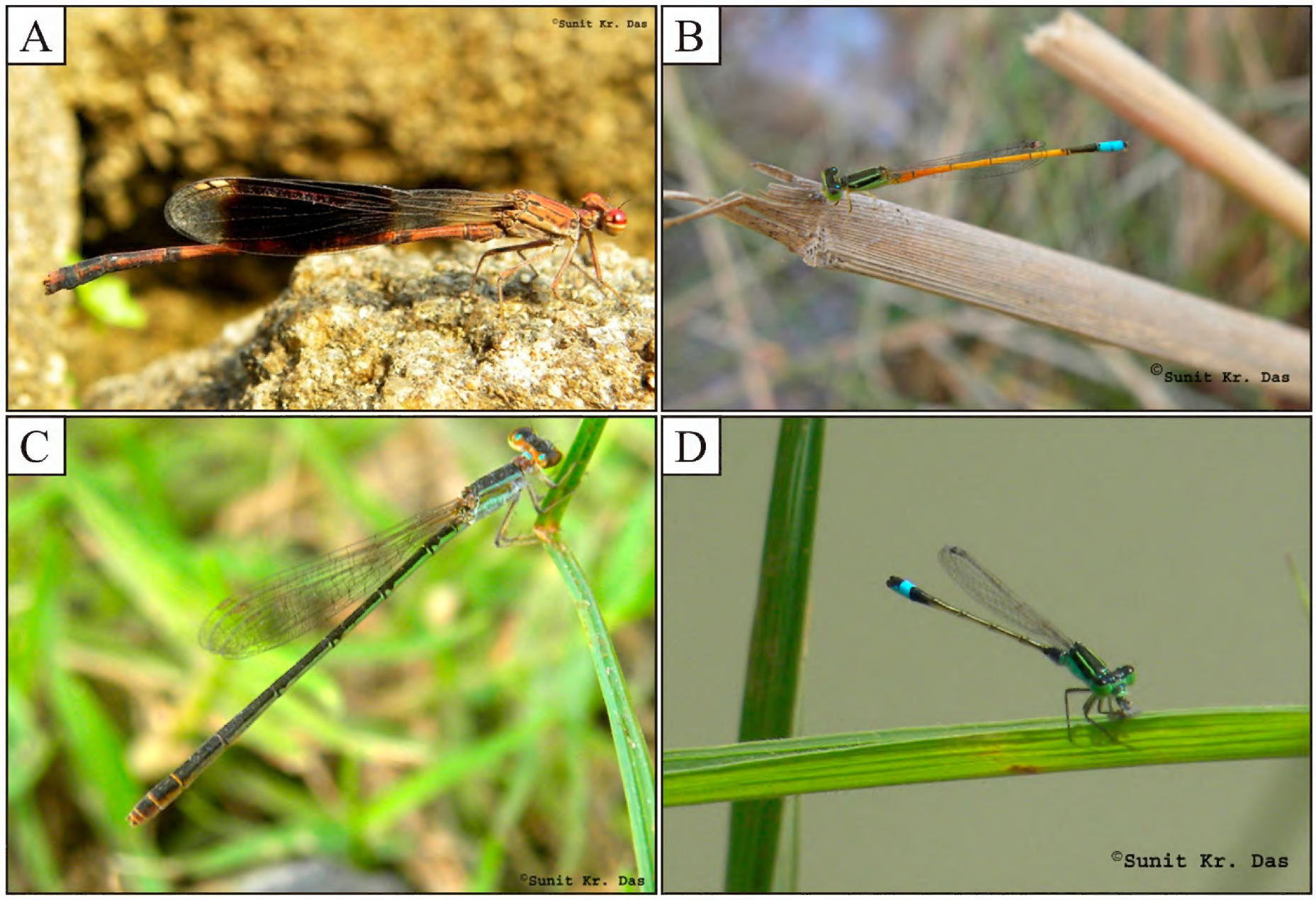

FIGURE 2. Photographs of Damselflies (suborder-Zygoptera A-D). A. *Disparoneura quadrimaculata* B. *Ischnura aurora*, C. *Agriocnemis pygmea*, D. *Ischnura senegalensis*. (Photo by Sunit Kr. Das).

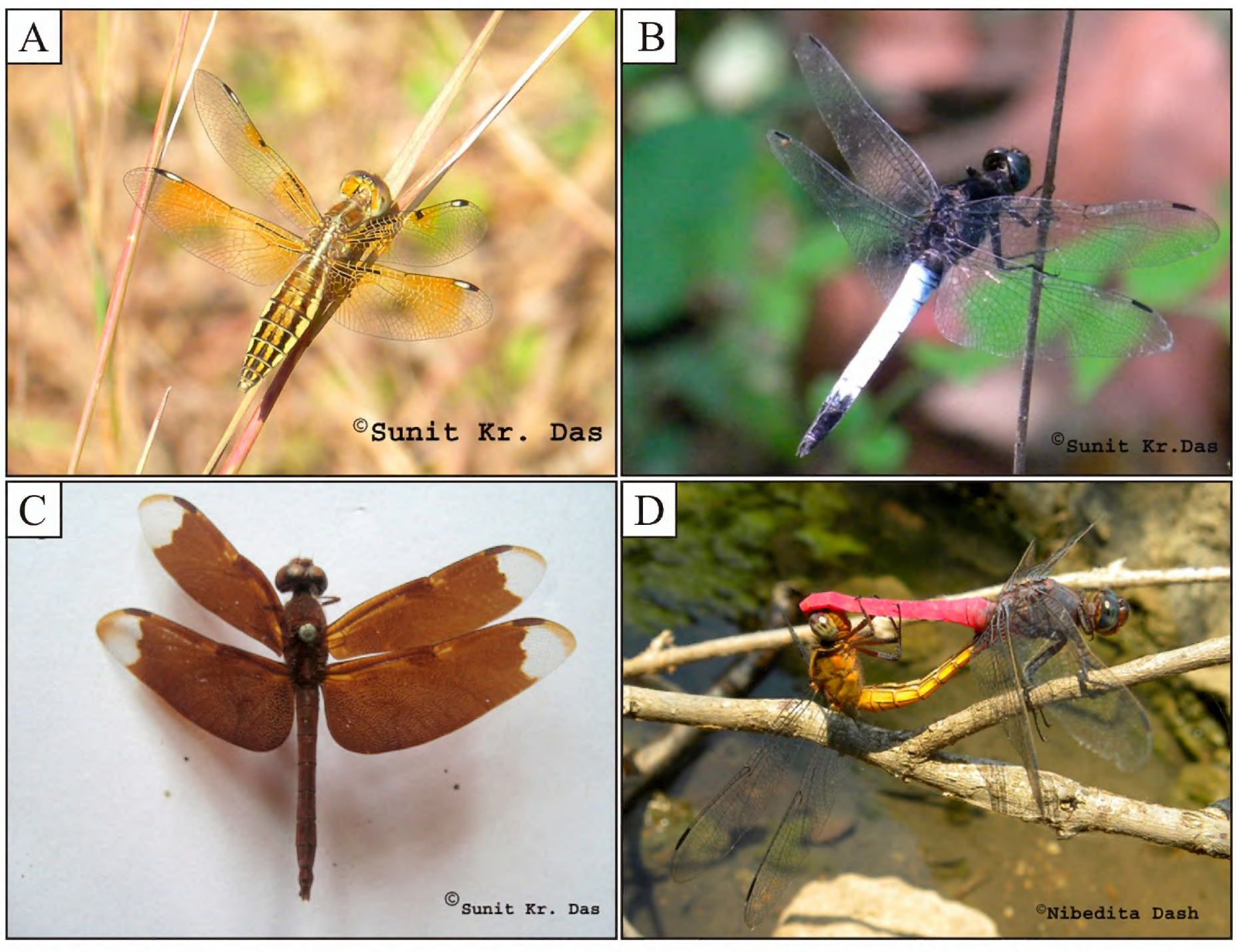

FIGURE 3. Photographs of Dragonflies (suborder-Anisoptera A-D). A. *Palpopleura sexmaculata*, B. *Brachydiplax sobrina*, C. *Neurothemis fulvia*, D. *Orthetrum pruinosum* (couple mating) (Photo by Sunit Kr. Das A-C and Nibedita Dash, D).

Table 1. Checklist of odonates recorded in three selected Tiger Reserves of Madhya Pradesh, Central India (+ present; - absent).

SL NO.	FAMILY/ SCIENTIFIC NAME	TIGER RESERVES		
		KANHA	PENCH	BANDHABGARH
I	**COENAGRIONIDAE**			
1	*Agriocnemis pygmea* (Rambur,1842)	+	+	+
2	*Ceriagrion coromandelianum* (Fabricius.,1798)	+	+	+
3	*Ceriagrion cerinorubellum* Brauer,1865	+	+	+
4	*Ceriagrion olivaceum* Laidlaw,1914	+	+	+
5	*Ischnura aurora* (Brauer,1865)	+	+	+
6	*Ischnura senegalensis* (Rambur,1842)	+	+	+
7	*Pseudagrion microcephalum* (Rambur,1842)	+	+	+
8	*Pseudagrion rubriceps* Selys,1876	+	+	+
9	*Aciagrion pallidum* Selys, 1891	+	+	+
10	*Disparoneura quadrimaculata* (Rambur 1842)	+	+	-
II	**LESTIDAE**			
11	*Lestes viridulus* Rambur,1842	+	-	-
12	*Lestes umbrinus* Selys, 1891	+	+	+
13	*Lestes elatus* Hagen in Selys,1862	+	+	+
III	**CALOPTERYGIDAE**			
14	*Neurobasis chinensis* (Linnaeus,1758)	+	-	-
15	*Vestalis apicalis* Selys,1873	+	-	-
	PLATYCNEMIDIDAE			
16	*Copera marginipes* Rambur, 1842	+	-	-
IV	**GOMPHIDAE**			
17	*Ictinogomphus rapax* Rambur,1842	+	+	+
18	*Paragomphus lineatus* (Selys,1850)	+	+	-
V	**AESHNIDAE**			
19	*Anaciaeschna jaspidea* (Burmeister,1839)	+	+	+
20	*Anax guttatus* (Burmeister,1839)	+	+	+
21	*Anax immaculifrons* Rambur,1842	+	+	+
VI	**LIBELLULIDAE**			
22	*Acisoma panorpoides* Rambur,1842	+	+	+
23	*Aethriamanta brevipennis* (Rambur,1842)	+	+	+
24	*Brachythemis contaminata* (Fabricius,1793)	+	+	+
25	*Bradinopyga geminata* (Rambur,1842)	+	+	+
26	*Crocothemis servilia* (Drury,1770)	+	+	+
27	*Diplacodes trivialis* (Rambur,1842)	+	+	+
28	*Diplacodes nebulosa* Fabricius, 1793	+	+	-
29	*Neurothemis fulvia* (Drury,1773)	+	+	+
30	*Neurothemis tullia* (Drury,1773)	+	+	+
31	*Orthetrum pruinosum* (Rambur,1842)	+	+	+
32	*Orthetrum sabina* (Drury,1770)	+	+	+
33	*Orthetrum triangulare* (Selys,1878)	+	+	+
34	*Orthetrum glaucum* Brauer, 1865	+	+	+
35	*Orthetrum luzonicum* Brauer, 1868	+	+	+
36	*Palpopleura sexmaculata* Fabricius,*1787*	-	+	-
37	*Pantala flavescens* (Fabricius,1798)	+	+	+
38	*Potamarcha congener* (Rambur,1842)	+	+	+
39	*Rhodothemis rufa* (Rambur,1842)	+	-	+
40	*Rhyothemis variegate* Linnaeus.,1763	+	+	+
41	*Tholymis tillarga* (Fabricius,1798)	+	-	+
42	*Tramea basilaris* Kirby,1889	+	+	+
43	*Brachydiplax sobrina* Rambur, 1842	-	+	-
44	*Trithemis aurora* (Burmeister,1839)	+	+	+
45	*Trithemis festiva* (Rambur,1842)	+	+	+
46	*Trithemis kirbyi* Selys,1891	-	+	-
47	*Trithemis pallidinervis* Selys,1889	+	+	+

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